

CHAPTER 6—DEFERRED CONSTRUCTION AND REPAIR/RENOVATION

HIGHLIGHTS

- In 1998, 54 percent of research-performing institutions reported that science and engineering research space construction or repair/renovation projects were needed but not funded.
- The cost of these deferred projects was \$11.4 billion. Sixty-one percent of deferred capital project needs were for construction and 39 percent were for repair/renovation (table 6-1).
- The top 100 institutions accounted for 63 percent of the total deferred costs, other doctorate-granting institutions accounted for 30 percent, and nondoctorate-granting accounted for 7 percent (table 6-1).
- Seventy-six percent (\$8.7 billion) of total deferred capital project costs were included in institutional plans (table 6-1).
- The largest deferred project costs reported by research-performing institutions were for the physical sciences, \$2.5 billion, and for the biological sciences outside of medical schools, \$2.1 billion (table 6-3).
- Total deferred S&E research facilities needs (\$11.4 billion) combined with deferred central campus infrastructure needs (\$767 million) result in an estimate of \$12.2 billion in total deferred S&E-related construction and repair/renovation project costs. This 1998 estimate of deferred costs represents an increase of \$1.7 billion in adjusted dollars over deferred cost estimates in 1996.

INTRODUCTION

Of central importance to the National Science Foundation's Survey of Scientific and Engineering Research Facilities at Colleges and Universities is determining the needs of research-performing institutions either for additional science and engineering research space or for the repair/renovation of existing space. The original mandate to conduct this biennial survey states:

The National Science Foundation is authorized to design, establish, and maintain a data collection and analysis capability in the Foundation for the purpose of identifying and assessing the research facilities needs of universities and colleges. (42 U.S.C. 1886)

This chapter provides one way of estimating need. It reports the costs of deferred projects for construction and repair/renovation that are necessary to meet existing S&E research commitments but that are not funded.

Like the 1996 Survey of Scientific and Engineering Research Facilities at Colleges and Universities, the 1998 survey included a question designed to determine construction and repair/renovation costs that institutions had deferred. Institutions reported separately those construction and repair/renovation costs for projects that were included in an institutional plan and those not included in an institutional plan.

Four criteria were used to define deferred projects (see Item 7 of the survey in Appendix C):

- The project must be necessary to meet the current S&E research program commitments;
- The project was not scheduled for fiscal year 1998 or 1999;
- The project was not funded; and
- The project was neither for the purpose of developing new programs nor for expanding faculty beyond what is required to fulfill current S&E research program commitments.

Institutions also were asked to report their deferred central campus infrastructure construction and repair/renovation needs. These deferred needs were defined using the same criteria as for facilities, and institutions were asked to report separately those deferred needs in institutional plans and those not in such plans. Central campus infrastructure was defined as those systems that exist between the buildings of a campus and the non-architectural elements of campus design.

FINDINGS

DEFERRED CAPITAL PROJECTS FOR S&E RESEARCH FACILITIES

In 1998, 54 percent of research-performing institutions reported construction or repair/renovation projects, or both, that were needed but not funded. Two years earlier, a similar proportion of institutions, 55 percent, reported some type of deferred capital project. The vast majority of institutions (87 percent) that had deferred projects had included at least some of these projects in an approved institutional plan. Forty-four percent of the colleges and universities that reported deferred projects also identified projects that were not included in an approved institutional plan.²⁴

The total estimated cost for deferred S&E research construction and repair/renovation projects in 1998 was \$11.4 billion. This total includes both projects that were in institutional plans and those that were not (table 6-1).

Slightly over three quarters of the total deferred capital project costs reported by institutions (76 percent or \$8.7 billion) were included in institutional plans. Both

types of doctorate-granting institutions reported that about 75 percent of their deferred capital project costs were included in an institutional plan; nondoctorate-granting institutions reported that 90 percent of their deferred capital project costs were included in plans. While 84 percent of all deferred construction project costs were included in institutional plans, 65 percent of deferred repair/renovation project costs were a part of overall institutional plans.

Overall, 61 percent of all deferred capital project needs, both those included in institutional plans and those not included, were for construction. The estimated cost for these projects totaled \$7.0 billion. All types of institutions reported greater deferred construction costs than repair/renovation costs. However, construction costs included in institutional plans exceeded repair/renovation costs included in plans in all types of institutions, while deferred repair/renovation costs not in plans were greater than construction costs not in plans.

The top 100 institutions accounted for 63 percent of the total deferred need, both those in and not in plans. Other doctorate-granting institutions accounted for 30 percent of the total deferred costs. Nondoctorate-granting institutions accounted for 7 percent of the total deferred capital project costs (table 6-1).

²⁴ The 1996 data are from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 6-1.

Table 6-1. Estimated costs for deferred capital projects to construct or repair/renovate science and engineering (S&E) research facilities by institution type, project type, and whether the project was included in an institutional plan: 1998

Institution type	Included in institutional plans			Not Included in institutional plans			Total
	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	Subtotal	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	Subtotal	
	In millions of dollars						
Total.....	5,857	2,834	8,691	1,142	1,548	2,690	11,381
Doctorate-granting.....	5,405	2,546	7,950	1,118	1,487	2,605	10,555
Top 100 in research expenditures.....	3,685	1,714	5,399	731	1,025	1,755	7,154
Other.....	1,719	832	2,552	388	462	849	3,401
Nondoctorate-granting.....	452	288	740	24	61	85	826

NOTE: Components may not sum to totals due to rounding.

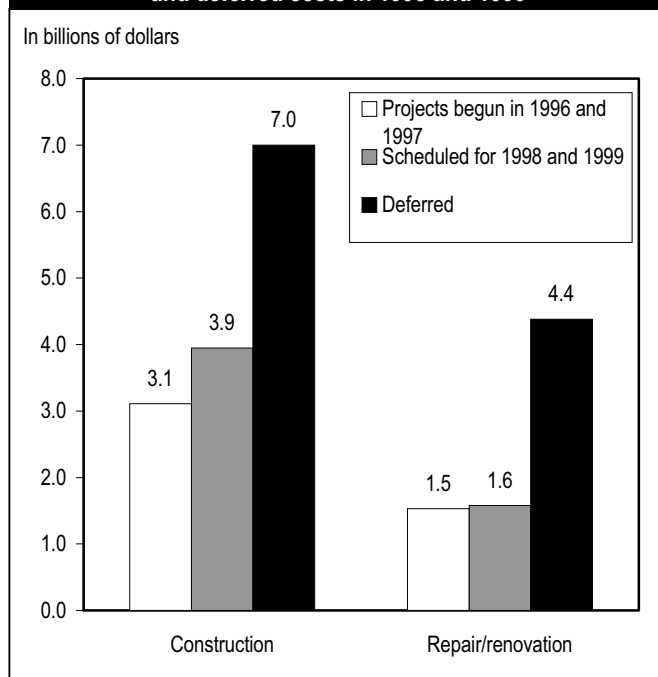
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

DEFERRED PROJECT COSTS AND CAPITAL PROJECT COMMITMENTS

Comparing estimated deferred project costs to the costs of capital projects begun in 1996 and 1997 and those scheduled for 1998 and 1999 provides a perspective on the magnitude of estimated deferred need. Deferred construction costs (\$7.0 billion) are approximately equal to the combined construction begun in 1996 and 1997 (\$3.1 billion) and construction scheduled for the following two fiscal years (\$3.9 billion). Deferred repair/renovation costs (\$4.4 billion) exceed the combined repair/renovation commitments for 1996 and 1997 (\$1.5 billion) and those scheduled for 1998 and 1999 (\$1.6 billion) (figure 6-1).

Excluding estimated deferred costs not included in institutional plans still results in deferred need estimates that exceed the actual cost of project starts for 1996 and 1997. This is the case for both deferred construction projects and deferred repair/renovation projects.

Figure 6-1. Cost of construction and repair/renovation of science and engineering research facilities begun in 1996 and 1997, scheduled for 1998 and 1999, and deferred costs in 1998 and 1999



NOTE: Includes all construction projects costing more than \$100,000 and repair/renovation projects costing more than \$100,000. Repair/renovation projects begun in 1996 or 1997 also include all projects costing more than \$5,000.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

DEFERRED NEED ESTIMATES

Between 1996 and 1998, deferred capital project costs increased from \$9.9 billion to \$11.4 billion, a 15-percent increase in adjusted dollars (table 6-1).²⁵ Overall, the other doctorate-granting institutions reported the largest overall increase in deferred capital project costs, a 69-percent increase.

The largest relative increase in deferred costs during this time period occurred for repair/renovation projects not included in institutional plans, from \$0.9 billion to \$1.5 billion. This represents a 67-percent increase. Deferred S&E research construction projects included in institutional plans increased 20 percent, from \$4.9 billion to \$5.9 billion.

Changes in the portion of deferred construction and repair/renovation need that is included in institutional plans can be compared for three survey periods, 1994,²⁶ 1996, and 1998 (table 6-2). Across all types of institutions, the estimated cost of deferred construction and repair/renovation projects increased from \$6.5 billion in 1994 to \$8.7 billion in 1998. The deferred need estimates of doctorate-granting institutions included in institutional plans increased from \$6.0 billion in 1994 to \$8.0 billion in 1998, a 31-percent increase.

In absolute dollars, estimated deferred construction projects increased \$1.2 billion, or 27 percent. In relative terms, estimated deferred repair/renovation projects increased more than construction projects, \$899 million, or 46 percent.

DEFERRED NEEDS BY S&E FIELD

Total deferred project costs were highest for the physical sciences, \$2.5 billion (table 6-3). Total deferred project costs of \$2.1 billion were reported for the biological sciences outside of medical schools. These two fields alone account for approximately 40 percent of all deferred capital project costs. The deferred project costs for two additional fields (engineering and the medical sciences in medical schools) exceed \$1 billion. These four fields represent 66 percent of all deferred capital projects. Institutions reported the lowest deferred costs for capital projects in mathematics and other sciences, \$182 and \$188 million, respectively.

²⁵ Ibid.

²⁶ The 1994 survey only asked about deferred projects that were included in institutional plans.

Table 6-2. Trends in deferred need estimates included in institutional plans for science and engineering construction and repair/renovation: 1994, 1996, and 1998

Institution type	1994			1996			1998		
	Construction	Repair/ renovation	Total	Construction	Repair/ renovation	Total	Construction	Repair/ renovation	Total
In millions of constant 1997 dollars									
Total.....	4,614	1,935	6,548	4,884	2,943	7,827	5,857	2,834	8,691
Doctorate-granting:	4,387	1,662	6,049	4,544	2,632	7,176	5,405	2,546	7,951
Top 100 in research expenditures.....	3,218	1,199	4,418	3,671	1,744	5,415	3,685	1,714	5,399
Other.....	1,169	463	1,631	872	888	1,760	1,719	832	2,551
Nondoctorate-granting...	227	272	499	340	311	651	452	288	740

NOTE: Components may not sum to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 6-3. The cost of deferred capital projects to construct or repair/renovate science and engineering (S&E) research facilities by field, type of project, and whether the project was included in an institutional plan: 1998

Institution type	Included in institutional plans		Not included in institutional plans		Total
	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	
	In millions of dollars				
Total.....	5,590	2,674	1,102	1,474	10,840
Biological sciences—					
inside medical schools.....	267	160	40	74	540
outside medical schools.....	976	505	273	348	2,101
Physical sciences.....	1,339	596	212	305	2,453
Psychology.....	107	71	30	33	242
Social sciences.....	136	110	44	67	357
Mathematics.....	83	75	5	19	182
Computer sciences.....	198	25	38	35	297
Earth, atmospheric, and ocean sciences.....	327	106	71	42	545
Engineering.....	878	556	166	144	1,744
Agricultural sciences.....	422	165	64	117	768
Medical sciences—					
inside medical schools.....	689	274	109	184	1,256
outside medical schools.....	333	129	71	174	707
Other sciences.....	102	62	18	6	188

NOTE: Components may not sum to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

DEFERRED CAPITAL PROJECTS FOR CENTRAL CAMPUS INFRASTRUCTURE

The facilities in which S&E research is conducted are supported by a campus infrastructure of walkways and roads, wiring for telecommunications and electricity, sewers and drains, air handling, waste storage and disposal, and the like. It is difficult to establish how much of this central campus infrastructure supports the work of S&E research and how much supports other academic and nonacademic needs.

In 1998, research-performing institutions estimated deferred construction and repair/renovation costs affecting their central campus infrastructure to be \$2.6 billion (table 6-4). Over three-fourths (77 percent) of the total deferred cost to either construct or repair/renovate the central campus infrastructure was included in institutional plans. The percentage of total deferred costs included in institutional plans ranged from 65 percent at nondoctorate-granting institutions to 79 percent at other doctorate-granting institutions.

The estimated \$2.6 billion in deferred central campus infrastructure costs is in addition to the \$11.4 billion in deferred costs for construction and repair/renovation identified above. Because 59 percent of all academic space is devoted to S&E, and 50 percent of that space is research space (see table 1-2), a conservative prorated

estimate of S&E research needs for central campus infrastructure is \$767 million ($\$2.6 \text{ billion} \times .59 \times .50$). It should be noted that: (1) S&E research is probably more demanding of central campus infrastructure than other space, and (2) it is more difficult to prorate infrastructure costs than research facilities costs. Thus, \$767 million should be interpreted as a conservative estimate of the S&E research infrastructure deferred project costs.

Combining this \$767 million for campus infrastructure costs with the \$11.4 billion in deferred S&E research capital projects noted above, the total deferred S&E research facilities and infrastructure needs of colleges and universities is estimated to be \$12.2 billion.²⁷ This overall estimate of deferred need represents an increase of \$1.7 billion over 1994–95 levels.²⁸

²⁷ This estimate of deferred need, along with all others reported in this chapter, is potentially a lower estimate than would be derived from responses to other types of questions and calculations. By limiting the concept of need to current “research program commitments,” respondents were forced to consider only those R&D activities that were budgeted, approved, and funded. Such boundaries precluded institutions from reporting desired space in fields in which they did not currently have a research program. Calculations based on broader definitions of need would yield higher estimates.

²⁸ These data come from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, page 6-11. The values presented here have been adjusted for inflation.

Table 6-4. The cost of deferred capital projects to construct or repair/renovate central campus infrastructure by institution type, type of project, and whether the project was included in an institutional plan: 1998

Institution type	Included in institutional plans			Not included in institutional plans			Total
	To construct new central campus infrastructure	To repair/renovate existing central campus infrastructure	Subtotal	To construct new central campus infrastructure	To repair/renovate existing central campus infrastructure	Subtotal	
In millions of dollars							
Total.....	634	1,374	2,008	210	380	589	2,597
Doctorate-granting.....	560	1,297	1,857	209	300	509	2,366
Top 100 in research expenditures.....	349	820	1,169	149	177	325	1,495
Other.....	211	477	688	60	123	184	871
Nondoctorate-granting.....	74	77	151	1	80	80	231

NOTE: Components may not sum to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.